REMARKS

The Office Action rejects the claims in view of Ishikawa, Koide, Razeghi, Shakuda, and Schetzina. In each rejection, the Office Action points to layers in the electrically functional/active component as similar to the inactive intermediate multiple layer buffer of the present application. Although the descriptions of the layers of the electrically functional/active components are similar to the inactive intermediate buffer layers of the present invention, they are actually quite different because they serve a distinctly different purpose.

There are three major components in each of the references: a substrate, an electrically functional/active component, and an inactive buffer between the functional component and the substrate that aids in structurally connecting the functional component to the otherwise incompatible substrate. Although functional components in most semiconductor devices include many layers of various kinds, these layers are not part of a buffer. Applicants' invention is an inactive intermediate multi-layered buffer between a substrate and the functional component (group-III nitrides), and independent claims 1 and 12 of the application have been amended to clarify that the multi-layered buffer is an inactive intermediate layer.

The discussion below of each reference points out which layer or layers serve as a buffer, how each differs from the buffer of the claims of the present application, and which layers do not serve as a buffer and therefore are not comparable because they serve a different function and are part of a different operational part of the structure.

Section 102 Rejection

The Office Action rejects claim 12 under 35 U.S.C. 102(e) as anticipated by Ishikawa. Ishikawa discloses a technology to make a specific light emitting diode having a capacitor. Ishikawa uses a single InAlGaN layer as a buffer layer (see col. 8, lines 13-17, describing buffer layer 120),

and a multiple quantum well structure (a periodic structure with two different layers) as the active layer. Ishikawa does not disclose anything about multi-layered buffer technology, unlike claim 12 of the present application as amended, which now claims "an inactive intermediate multi-layered buffer having at least three layers . . . "

The Office Action states that Ishikawa "discloses a layer 103 . . . [that] includes one or more pairs of a thin GaN layer and a thin InGaN and an additional GaN layer." Layer 103 is described in col. 6, lines 44-46, as having "for example, thin GaN layers and thin InGaN layers alternately". However, layer 103 is not fabricated as a buffer layer. It is an active layer (col. 6, lines 44-45) and is an integral part of the LED. Referring to Fig. 2(a) of Ishikawa, the LED is composed of layers 102, 103, 104, 107 and 108. The invention of Ishikawa lies in a capacitor added in parallel with the LED. The capacitor includes the parallel conductive plates 108 and 105, separated by the insulator 106. This, as shown in Fig. 2(a), is connected in parallel with the LED, making contact at the top of the LED with electrode 108 and at the bottom of the LED with the electrode 105. Ishikawa mounts the LED on the sapphire substrate 101 using the buffer layer 120. It is the buffer layer 120 that must be compared with the multi-layered buffer of the present application, and not the active LED component 103. Ishikawa describes the buffer layer 120 at col. 8, lines 41-44, as "a thin buffer layer 120 of $In_xAl_yGa_{(i-x-y)}N$ . . ." Thus, Ishikawa does not teach or suggest the inactive intermediate multilayer buffer of amended claim 12. Applicants therefore believe that amended claim 12 now distinguishes over Ishikawa, and is allowable.

Section 103 Rejections

a. Koide

The Office Action rejects claims 1-6 and 8-14 under 35 U.S.C. 103(a) as unpatentable over Koide. The term "group-III nitride compound semiconductor" refers to structures often described as

light emitting diodes (LED). Koide describes an LED at col. 4, lines 43-53, as "a light-emitting layer 5 . . . " This device, including the layer described at col. 4, lines 43-53, is an LED which corresponds to the "group-III nitride compound semiconductor" of the second paragraph of claim 1 of the present application. Therefore, it does not correspond to or describe the content of the first paragraph of Applicant's claim 1, which describes the inactive intermediate buffer between the functional component and the substrate. The device of Koide also includes a buffer, and this is described by Koide at col. 4, lines 29-32, as "a 20 nm-thick buffer layer 2 made of AlN . . ." This is a single layer, and therefore does not teach or suggest the multi-layered buffer of the present invention. Applicants therefore believe that independent claim 1 distinguishes over Koide and is allowable. Claims 2-6, 8-11, 13 and 14 add further limitations to claim 1, and are therefore also believed to be allowable. Independent claim 12 is an apparatus claim reflecting the structure resulting from the method of claim 1, and thus the same logic applies. Applicants therefore also believe claim 12 is allowable.

b. Razeghi/Shakuda

The Office Action rejects claims 1-14 under 35 U.S.C. 103(a) as unpatentable over Razeghi in view of Shakuda. Razeghi discloses a technology for making a group-III-nitride superlattice structure. Razeghi uses a single AlN layer as a buffer layer on which Si-doped GaN and GaAlN layers, an un-doped GaN layer, and a Mg-doped GaN/GaAlN superlattice structure and GaN layer are grown (see Figure in Razeghi, and col. 5, lines 20-23). The multiple layers all involve the group-III-nitride structure that is mounted on the substrate through a single AlN buffer layer. Razeghi makes it clear that the AlN layer is the layer for buffer purposes at col. 4, lines 14-17, describing the AlN layer as "a stable layer that prevents oxygen and other impurities . . .from reacting with the semiconducting layer to be grown." In other words, the layers above the AlN buffer are the active semiconductor structure layers, and not buffer layers. Razeghi therefore does not teach or suggest an

inactive intermediate multi-layer buffer as described in amended independent claims 1 and 12 of the present application.

The Shakuda patent discloses a technology for making a GaN type light emitting device on a silicon substrate. Shakuda uses an insulating material, e.g. Si_3N_4, and a low temperature grown GaN layer as a buffer on which the LED is grown. The two layers of Shakuda do not teach or suggest the inactive intermediate multi-layered buffer of amended independent claims 1 and 12. The layers of claims 1 and 12 each are specified as having a thickness in the 2-6 nm range, whereas in Shakuda the buffer layers 23 and 24 are much thicker, with layer 23 having a thickness in the range of 0.01-0.2 μm (10-200 nm), and layer 24 in the range of 2-5 μm (2000-5000 nm). Also, Applicants' claims 1 and 12 specify at least three buffer layers in the range of 2-6 nm. Neither the 30 nm single layer of AlN in Razeghi (col. 5, line 21) nor the two 10-5000 nm layers of Shakuda teach or suggest the thin multi-layer buffer of amended claims 1 and 12. Applicants therefore believe amended independent claims 1 and 12 (and the claims depending on claim 1) distinguish over Razeghi/Shakuda, and are allowable.

c. Schetzina/Shakuda

The Office Action rejects claims 1-14 under 35 U.S.C. 103(a) as unpatentable over Schetzina in view of Shakuda. Schetzina describes what is called "an integrated heterostructure device" (col. 9, lines 52-58). An example of such a device is shown in Fig. 3 and described generally at col. 10, lines 12-23. A semiconductor device 110 and ohmic contacts 120a and 120b make up the heterostructure device. This heterostructure device is grown on a substrate 132 (n-SiC or sapphire), with a single layer 134 acting as a buffer, preferably constructed of n-ZnO. The term "substrate" for the sapphire is used at col. 11, line 34, and col. 15, line 56. The single buffer layer 134 is described at col. 15, lines 63-67. Schetzina therefore does not describe a multi-layer buffer. As described above, Shakuda also does not describe the inactive intermediate multi-layered buffer claimed in the

present application. Thus, Schetzina and Shakuda can not be combined to teach or suggest the buffer of Applicants' amended claims 1 and 12. Applicants therefore believe claims 1 and 12, and dependent claims 2 - 11 and 13 – 14, are allowable over Schetzina/Shakuda.

CONCLUSION

Applicants have amended the claims to distinguish the present invention from the cited art, and provided an explanation of why the buffers shown in the cited art do not teach or suggest the inactive intermediate multi-layered buffer of the present invention. Applicants believe the claims now describe a novel and useful invention, and respectfully request a Notice of Allowance.

If any further questions should arise prior to a Notice of Allowance, the Examiner is respectfully invited to contact the attorney at the number set forth below.

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Respectfully submitted,

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CERTIFICATE OF MAILING

I, Diana Dearing, certify that the enclosed papers are being deposited with the U. S. Postal Service as first class mail in an envelope addressed to: MAIL STOP RESPONSE - NO FEE, Commissioner for Patents, P. O. Box 1450, Alexandria, VA 22313-1450 on 8-13, 2003.

Diana Dearing